2009

City of Atlanta Greenhouse Gas Emissions Inventory

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Background

To support Mayor Shirley Franklin's initiative for a sustainable Atlanta, a student-faculty team from the Georgia Institute of Technology has been working with the City of Atlanta to estimate the city government's greenhouse gas emissions. The determination of greenhouse gas emissions establishes a baseline to measure future emission reduction progress.

This report includes greenhouse gas emissions that result directly from use of fuels, energy, and refrigerants. City of Atlanta facilities include the water treatment and sewage treatment facilities, parks and recreational facilities, correctional facilities, fire and police facilities, some airport accounts, and general administrative offices. Also included in this analysis are terminals and concourses at the Hartsfield-Jackson Atlanta International Airport, which comprise the Atlanta Airlines Terminal Corporation (AATC). The data and calculations presented here reflect information available from the City of Atlanta as of February 2009. The results may be revised as additional data become available.

Table 1 summarizes the City of Atlanta's electricity, natural gas, and fuel consumption for 2007, as well as emissions of refrigerants, wood waste collected, and waste sent to landfills.

Table 1: 2007 City of Atlanta Energy and Greenhouse Gas Emitting Activities

Facility Electricity (million kWh)	340
Facility Natural Gas (million therms)	6.9
AATC Electricity (million kWh)	210
AATC Natural Gas (million therms)	1.8
Outdoor Lighting (million kWh)	44
Traffic Signals (million kWh)	12
Diesel Fuel (million gal)	1.4
Gasoline (million gal)	1.5
Jet Fuel (thousand gal)	29
R-134a Refrigerant (thousand lbs)	1.5
R-123 Refrigerant (thousand lbs)	0.6

Freon-22 Refrigerant (thousand lbs)	1.5
R-11 Refrigerant (thousand lbs)	0.3
Yard Waste (thousand tons)	24.5
Landfill Waste (million kg)	5

Electricity and Natural Gas Usage

The City of Atlanta provided electricity and natural gas bills and usage data for 2007, and some data for 2005 and 2006. The City also provided departmental totals for electricity and natural gas consumption in 2007 which are shown in Table 2.[1],[2]

[1] Electricity data was derived from summary bills provided by Georgia Power, and is subject to update in the future as corrections are made to noted errors.

[2] Emissions from electricity and natural gas in city-owned facilities leased to others are excluded based on best-available records of city properties. These exclusions are subject to change based on future findings regarding property status.

Table 2: 2007 City of Atlanta Electricity and Natural Gas Use by Department

Department	Electricity (million kWh)	Natural Gas (thousand therms)		
		From GA Natural Gas	From other Gas Vendors	Total
Office of Enterprise Assets Management (OEAM)	35	66	205	272
Atlanta Fire Dept. (AFD)	3	160	1	26
Atlanta Police Dept. (APD)	3	32		32
Dept. of Public Works (DPW)	5	313		313
Dept. of Watershead Management (DWM)	221	758	4,542	5,300
Dept. of Corrections (DoC)	10	276		276
Dept. of Parks, Recreation & Community Affairs (DPRCA)	22	354		354
Economic Development - Underground	1			
Dept. of Aviation (DoA - non-AATC)	36	172		172
Facilities Total	**337**	**2,132**	**4,748**	**6,880**
AATC	210		1,751	1,751
Traffic Signals	12			
Outdoor Lighting	44			
Total COA	**603**	**2,132**	**6,499**	**8,631**

Outdoor Lighting

Atlanta's outdoor lighting fixtures and traffic signals are not metered. For outdoor lighting, the estimated monthly electricity use for each wattage category was calculated by multiplying the number of fixtures by the estimated energy usage per lamp provided by Georgia Power[3].

[3] Electric service tariff: Outdoor Lighting Service Governmental Customers Schedule: "OLG-3". Retrieved on March 5, 2008 from: http://www.georgiapower.com/pricing/gpc-pdf/OLG-3.pdf.

Traffic Signals

For traffic signals, monthly electricity usage was available for only January 2007, and data on the number of LED and incandescent traffic signals and their respective power use was available for January 2008. Total traffic light energy use was estimated by assuming that all traffic lights were incandescent in 2005 and that the transition to LEDs began in 2007.

Liquid Fuels

The City's use of diesel fuel, gasoline, and jet fuel was provided by the City for the year 2007. This is fuel purchased by the City and dispensed at City fueling locations. As of 2006, the City had approximately 3,100 on-road vehicles and 1,800 off-road vehicles such as bulldozers and lawn and garden equipment, and median usage of the on-road vehicles is about 6,000 miles per year.[4] The majority of the jet fuel is used to power the city's helicopter. 4,000 gallons of fuel is used for other purposes such backup power and heating.

Vehicle Refrigerants

Fleet Services used 680 kg (1500 pounds) of R-134a refrigerant for vehicle air conditioners in 2007, corresponding to 970 metric tons of CO_2 equivalent.

Refrigerants Used in Buildings

The City provided data on facility refrigerant use for September 6, 2007 through July 23, 2008. The City used 694 kg (1531 lbs) of Freon-22, 272 kg (600 lbs) of R-123, and 136 kg (300 lbs) of R-11 refrigerant.

Yard Waste

In 2007, the City contracted for 24,500 tons of chipped yard waste to be transported to facilities in Alabama. This material is used as fuel at mills in Stevenson, Cottonton, and Selma. An estimated 55,000 gallons of diesel fuel was used to transport the 900 loads of this material. The use of this wood waste as fuel is assumed to displace

[4] City of Atlanta, City Vehicle Fleet Analysis, July 20, 2006.

the use of diesel fuel. In principle this could provide a CO_2 credit of 17,000 metric tonnes of CO_2 for burning wood rather than fossil fuel, minus 550 metric tonnes of CO_2 for transport of the wood waste to the industrial site in Alabama, for a total of 16,450 metric tonnes per year of CO_2 reductions from the City's use of this renewable fuel. However, following greenhouse gas emission account protocols, this credit is not included in the City's greenhouse gas inventory because the wood fuel is not used by the City of Atlanta.

Transport of the City's Waste to Landfills

Landfill waste resulting from City operations is estimated to be on the order of 5,000 metric tonnes per year with an upper limit of 10,000 metric tonnes per year. Transporting this material to landfills requires about 500 trips of a 40-ton container.

Wastewater Treatment

Wastewater treatment facilities can produce methane and nitrous oxide. The City of Atlanta operates four wastewater treatment facilities: Utoy Creek, South River, Intrenchment Creek, and R. M. Clayton. Emissions from wastewater treatment occur throughout the process. Methane may be emitted from the incomplete combustion of biogas from anaerobic digestion. Nitrous oxide may be emitted from the centralized wastewater treatment process and the effluent released to aquatic environments.[5]

Utoy Creek and South River are believed to produce significantly less methane than R. M. Clayton or Intrechment Creek from anaerobic digesters. In 2007, 282 million cubic feet of digester gas was produced at R.M. Clayton WRC. In general this methane can be used to heat the digesters, but in 2007 the methane was simply flared and natural gas was used to heat the digesters. At Intrenchment Creek, 1.25 million cubic feet of digester gas was produced, all of which was flared.

[5] Local Government Operations Protocol for the quantification and reporting of greenhouse gas emissions inventories, Version 1.0. (2008, September). Developed in partnership by: California Air Resources Board, California Climate Action Registry, ICLEI-Local Government for Sustainability, & The Climate Registry. Retrieved on February 4, 2009 from: http://www.icleiusa.org/programs/climate/ghg-protocol.

Landfill Methane

Landfills also produce greenhouse gases. As the material in them decays, landfills emits a combination of carbon dioxide and methane, in roughly equal proportions. The City of Atlanta owns four landfills, at Cascade Road, Key Road, Gun Club Road, and East Confederate Avenue. Cascade Road, Key Road, and Gun Club Road are all municipal waste landfills that are now closed and have measured landfill gas flows of 100, 360, and 350 cubic feet per minute, respectively.[6] The East Confederate Avenue landfill is for construction and demolition debris, which may have lower landfill gas emissions than municipal waste landfills, and does not have a landfill gas collection system.

Greenhouse Gas Emission Calculations

Carbon dioxide is emitted when fossil fuels, such as coal, natural gas, and petroleum, are combusted. Natural gas emits 5.2 kg CO_2/therm,[7] diesel fuel emits 10.1 kg CO_2/gallon, gasoline emits 8.8 kg CO_2/gallon, jet fuel emits 9.6 kg CO_2/gallon.[8,9,10] Carbon dioxide emissions from electricity depend on the fuel used to make the electricity, as well as on how efficiently the fossil fuel is converted into electricity. For the U.S. as a whole, electricity generation from coal-fired electric power plants releases about 0.95 kg of CO_2 per kWh (kilowatt-hour); electricity generation from natural gas-fired electric

[6] Data provided by James Swope, City of Atlanta, August 8, 2008.

[7] US DOE, ORNL, Carbon Dioxide Information Analysis Center, http://cdiac.ornl.gov/pns/faq.html

[8] US EPA, Emissions Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel. Retrieved April 8, 2008 from http://www.epa.gov/OMS/climate/420f05001.htm.

[9] ICLEI, an organization of local governments committed to sustainability, has developed software that some city governments have used to estimate their greenhouse gas emissions. That software, currently being revised uses conversion factors of 0.616 kg CO_2/kWh electricity, 5.59 kg CO_2/therm natural gas, 9.511 kg CO_2/gallon diesel, and 9.393 kg CO_2/gallon gasoline. Since most of the City of Atlanta greenhouse gas emissions calculated here are from use of electricity, and since ICLEI's electricity conversion factor is within one half of one percent of that used here, ICLEI-based analysis can be expected to be comparable to this analysis.

[10] Energy Information Administration. "Voluntary Reporting of Greenhouse Gases Program." Retrieved on September 1, 2008 from: http://www.eia.doe.gov/oiaf/1605/coefficients.html

power plants releases about 0.6 kg of CO_2 per kWh; and electricity generation from nuclear power and hydroelectric power releases 0 kg of CO_2 per kWh.[11]

The City of Atlanta purchases its electricity from Georgia Power. The 2007 Georgia Power fuel mix was 70% coal, 15% natural gas, 14% nuclear, and 1% hydroelectric. [12]

Georgia Power Company measures the emissions from its power plants. The emissions factors for carbon dioxide can be seen in Table 3. These factors change over time due to changes in the fuel mix used to generate the electricity. Demand levels and fuel prices can affect the type of fuel used to generate base load and peak load power.

Table 3: Georgia Power Company CO_2 Emissions Factors[13,14,15,16]

Year	lbs CO_2/kWh	kg CO_2/kWh
2005	1.576	0.715
2006	1.571	0.713
2007	1.563	0.709

[11] US DOE and US EPA. Carbon Dioxide Emissions from the Generation of Electric Power in the United States. July 2000, http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2report.html

[12] Georgia Power. 2007 Annual Report. http://files.shareholder.com/downloads/SO/466153217x0x187178/DFBD0125-A742-4CC0-B6FB-404043F63917/SoCo_complete_annual.pdf

[13] Provided by Markell Heilbron, Georgia Power Company Environmental Affairs.

[14] Other electricity emissions factors could have been chosen and reasonably justified, using, for example, the emissions corresponding to electricity generation in the entire state of Georgia or in the southeast as a whole. For example, Georgia's overall electric power generation is 63% coal, 9% natural gas, 23% nuclear, 2% hydroelectric, 0.6% petroleum, and 2.5% other renewables, and therefore has an electricity emission fact of 0.63 kg CO2/kWh. The states comprising the Southeastern Reliability Council South have an emission factor of 0.67 kg CO2/kWh, and the states comprising the somewhat larger Southeastern Reliability Council (SERC) have an emission factor of 0.62 kg CO2/kWh. Georgia Power's CO2 emission factor is used here because the City of Atlanta buys its electricity entirely from Georgia Power, and these purchases support Georgia Power's specific mix of fuels for electricity generation.

[15] US DOE EIA. State Electricity Profiles, 2006 Summary Statistics. Georgia.http://www.eia.doe.gov/cneaf/electricity/st_profiles/georgia.pdf

[16] USEPA. eGRID2007 Version 1.0. Year 2005 Summary Tables. Created September 2008.

These emissions factors only account for the emission released during the combustion of the fuel. Emissions from the acquisition, processing, and transportation of fuel are not included in these factors.

Besides carbon dioxide, refrigerants are also greenhouse gases. On a per-molecule basis, they have a much greater impact than carbon dioxide. R-134a has a carbon dioxide equivalence of 1,430, meaning that one kilogram of R-134a has the same greenhouse gas impact as 1,430 kilograms of CO_2.[17] The carbon dioxide equivalence of refrigerants varies widely. For instance, R-123 has a carbon dioxide equivalence of 77. In contrast, Freon-22 has a carbon dioxide equivalence of 1,810[12] and R-11 has a carbon dioxide equivalence of 4,750.[18]

Sulfur hexafluoride (SF_6) is used in transformers by some power providers. With a carbon dioxide equivalence of 22,800[17], SF_6 emissions are important, even though its use in transformers is being phased out.

Methane, another greenhouse gas, has a carbon dioxide equivalence of 21. It is released from sewage treatment plants, landfills, and any leakage in the natural gas system. It can also be released from certain agricultural processes like dairy farming.

Carbon dioxide equivalencies from the IPCC's Third Assessment Report (TAR) are used in this report. Many greenhouse gas inventories use carbon dioxide equivalencies from the IPCC's Second Assessment Report (SAR). When performing comparisons between inventories, it is important to use common carbon dioxide equivalencies. TAR values result in a 400 metric tonne increase over SAR values, which is less than 0.1% of the total greenhouse gas emissions of the City of Atlanta. Table 5 shows the carbon dioxide equivalencies for the SAR and TAR.

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[17] Working Group I of the Intergovernmental Panel on Climate Change. "Climate Change 2007: The Physical Science Basis." Cambridge University Press. New York: 2007. http://ipccwg1.ucar.edu/wg1/Report/AR4WG1_ Print_Ch02.pdf

[18] Working Group I of the Intergovernmental Panel on Climate Change. "Climate Change 2007: The Physical Science Basis." Cambridge University Press. New York: 2007. http://ipcc-wg1.ucar.edu/wg1/Report/ AR4WG1_ Print_Ch02.pdf

Table 4: Carbon Dioxide Equivalences

	Carbon Dioxide Equivalences	
Refrigerant/Gas	**SAR**	**TAR**
R-134a	1,300	1,430
R-123	90	77
Freon 22	1,500	1,810
R-11	3,800	4,750
SF6	23,900	22,800

Greenhouse Gas Emissions from Landfill Gas

Cascade Road, Key Road, and Gun Club Road are all municipal waste landfills that are now closed and have measured landfill gas flows of 100, 360, and 350 cubic feet per minute, respectively.[19] Landfill gas collection systems generally do not collect all of the landfill gas emitted by landfills; the standard default assumption is that 75% is collected.[20] Landfill gas is typically 50% methane, with most of the rest carbon dioxide.[21] This implies annual methane collection at these landfills is 530, 1910 and 1860 tons per year, respectively, for an annual total of 4300 tons of collected methane, and approximately 1400 tons of uncollected methane. Flaring the methane converts it to carbon dioxide, which is considered to make zero contribution to greenhouse gas emissions, since the released carbon dioxide is biogenic in origin. The collected methane could, in principal be used as an energy source. The 4,300 tons of collected methane (natural gas) is equivalent to about 2.2 million therms per year, equal to 32% of the natural gas use of City of Atlanta facilities.

[19] Data provided by James Swope, City of Atlanta, August 8, 2008.

[20] Personal Communication, Eli Yewdall and Cyrus Bhedwar, ICLEI, November 2008

[21] Sandelli, G. J. Demonstration of Fuel Cells to Recover Energy from Landfill Gas. Phase I Final Report. EPA-600-R-92-007, prepared for the US Environmental Protection Agency by International Fuel Cells Corporation. 1992.

Because each ton of methane has 21 times the global warming potential of a ton of carbon dioxide, the 1400 tons of uncollected methane is equivalent to 29,000 tons of carbon dioxide equivalent.

Greenhouse Gas Emissions from Wastewater Treatment

A variation of equation 10.1 from the Local Government Operations Protocol (LGOP), which itself was derived from the EPA document *Inventory of US Greenhouse Gas Emissions and Sinks*,[22] was used to calculate the methane released from incomplete combustion of methane during flaring.[5]

$$Annual\ CH_4\ emissions\ (metric\ tons) = G \times F_{CH_4} \times \rho_{CH_4} \times (1 - D) \times 0.0283 \times 10^{-6}$$

where G is standard cubic feet of digester gas produced per year, F_{CH_4} is the fraction of CH_4 in the gas and assumed to be 0.65, ρ_{CH_4} is the density of methane (662 g/m^3), and D is the destruction efficiency of methane when biogas is combusted which is assumed to be 99%. The value 0.0283 converts cubic feet to cubic meters and 10^{-6} converts grams to metric tons. Using this formula, the annual CH_4 emissions from R.M. Clayton WRC were about 34.4 metric tons or approximately 722 metric tons CO_2e.

At Intrenchment Creek, 1.25 million cubic feet of digester gas was produced, all of which was flared. Using the same method above, this was calculated to be equivalent to 0.15 metric tons CH_4 and 3.2 metric tons CO_2e.[23]

The energy value of the methane generated at R.M. Clayton wastewater treatment plant is equivalent to about 1.9 million therms of natural gas. This is more than 25% of the natural gas consumed by City of Atlanta facilities in 2007.

[22] Environmental Protection Agency. (2008, April). *Inventory of U.S. greenhouse gas emissions and sinks*. Retrieved on February 5, 2009 from: http://www.epa.gov/climatechange/emissions/downloads/08_CR.pdf.

[23] Data provided by Mesut Sezgin and Essam Hassan, City of Atlanta, Sept 9, 12 and 19, 2008.

Nitrous oxide is another greenhouse gas than can be emitted from wastewater treatment facilities. The following equation was used to calculate the nitrous oxide emissions from the wastewater treatment process with nitrification/denitrification: [5]

$$Annual\ N_2O\ Emissions\ (metric\ tons) = P \times EF \times 10^{-6}$$

where P is the total residential population and industrial population equivalent serviced by the wastewater treatment plants, EF is the emissions factor for N_2O equal to 7 g N_2O/person/year, and 10^{-6} converts grams to metric tons.

Using the estimated population of City of Atlanta in 2007 of 519,000,[24,25] the annual N_2O emissions are 3.6 metric tons per year from wastewater treatment processes. One metric ton of N_2O is equivalent to 310 metric tons of CO_2.[26] The annual N_2O emissions from wastewater treatment processes are equivalent to 1,127 metric tons CO_2e.

Annual N_2O emissions from effluent discharged into aquatic bodies was calculated using the following equation[5]:

$$Annual\ N_2O\ emissions\ (metric\ tons) = P \times (TN - N \times BOD_5\ load) \times EF \times \frac{44}{28} \times (1 - F) \times 365.25 \times 10^{-3}$$

where TN is the total nitrogen load in kg N/person/day, N is the nitrogen uptake for anaerobic system cell growth (0.005 kg N/kg BOD_5), BOD_5load is the kg BOD_5/person/day, EF is the emission factor of 0.005 kg N_2O-N/kg sewage-N produced,

[24] U.S. Census Bureau, Geographic Comparison Table, Georgia by Place. Retrieved on January 26, 2009 from: http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=04000US13&-_box_head_nbr=GCT-T1-R&-ds_name=PEP_2007_EST&-format=ST-9S

[25] This calculation is based on the residential population only, and may underestimate the population served, which is reported to include 1.5 million people including those who commute to work. Clean Water Atlanta, http://www.cleanwateratlanta.org/wastewater/

[26] U.S. EPA, Emission Facts: Metrics for Expressing Greenhouse Gas Emissions: Carbon Equivalents and Carbon Dioxide Equivalents. Retrieved on January 26, 2009 from: http://www.epa.gov/otaq/climate/420f05002.htm#1.

44/28 is the molecular weight ratio of N_2O to N_2, F is the fraction nitrogen removed (0.7), 365.25 converts days to years, and 10^{-3} converts kilograms to metric tons.

The annual emissions from effluent discharge of wastewater treatment plants into aquatic bodies are estimated to be 11.4 metric tons N_2O or 3,540 metric tons CO_2e, as shown in Figure 1. The total wastewater treatment greenhouse gas emissions are about 5400 metric tons CO_2e, which is about 1% of total greenhouse gas emissions from the City of Atlanta.

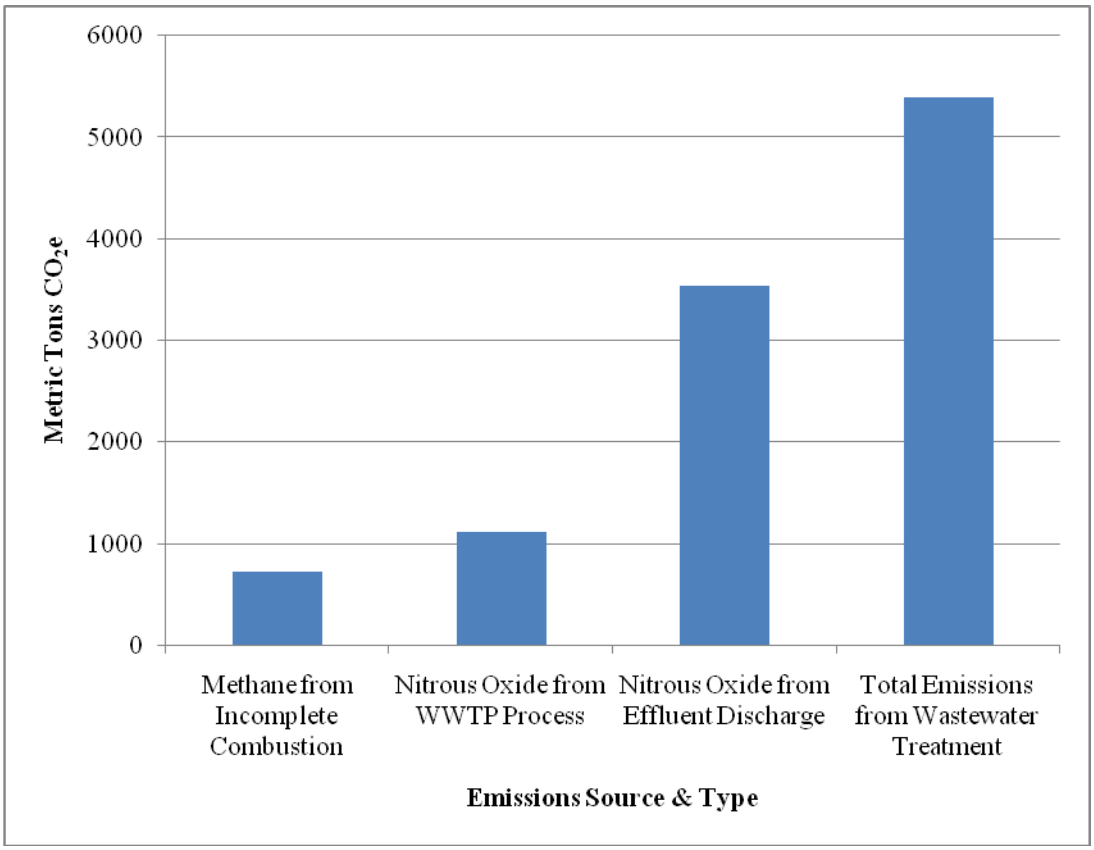

Figure 1: Wastewater Treatment Plant Emissions for 2007 by Source and Type (CO_2e)

City of Atlanta Greenhouse Gas Emissions

Table 5 and Figure 2 summarize the City of Atlanta's greenhouse gas emissions. The figure and table both show that electricity use in City of Atlanta facilities is by far

the largest component of the City's greenhouse gas emissions, accounting for nearly half of all emissions. The table also shows that electricity use rose slightly from 2005 to 2006 and was basically constant from 2006 to 2007.

Table 5: City of Atlanta Greenhouse Gas Emissions

	Net Greenhouse Gas Emissions (thousand metric tons CO_2e)		
Source	**2005**	**2006**	**2007**
Facility Electricity	220	240	240
Facility Natural Gas	---	---	36
AATC Electricity	130	140	150
AATC Natural Gas	8.9	8.1	9.1
Outdoor Lighting	---	---	31
Traffic Signals	8.5	8.5	8.2
Transportation Fuels	---	---	28
Wastewater Treatment	---	---	5.4
Refrigerants	---	---	2.9
Landfill Waste Transport	---	---	0.06
Landfill Gas	---	---	29
Total			**540**

(Numbers are rounded to two significant figures.)

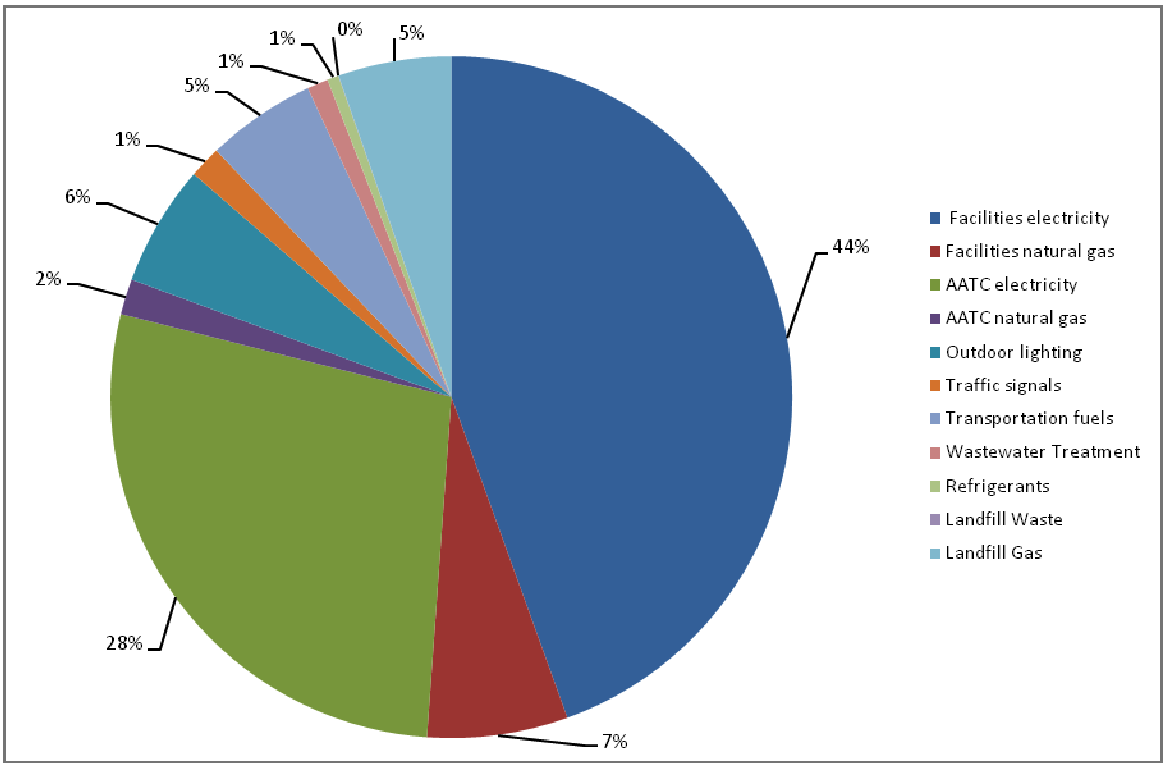

Figure 2: Percentage of Total Greenhouse Gas Emissions by Source and Type

Table 6 and Figure 3 show emissions by department from facility electricity and natural gas consumption.

Table 6: 2007 Emissions by Department

Department	Emissions (metric tonnes CO2)		
	Electricity	**Natural Gas**	**Total**
Office of Enterprise Assets Management (OEAM)	24995	1.4	24996
Atlanta Fire Dept. (AFD)	2145	0.8	2146
Atlanta Police Dept. (APD)	2212	0.2	2212
Dept. of Public Works (DPW)	3408	1.6	3410
Dept. of Watershead Management (DWM)	156978	27.6	157005
Dept. of Corrections (DoC)	7390	1.4	7392
Dept. of Parks, Recreation & Community Affairs (DPRCA)	15374	1.8	15376
Economic Development - Underground	800	0	800
Dept. of Aviation (DoA - non-AATC)	25730	0.9	25731

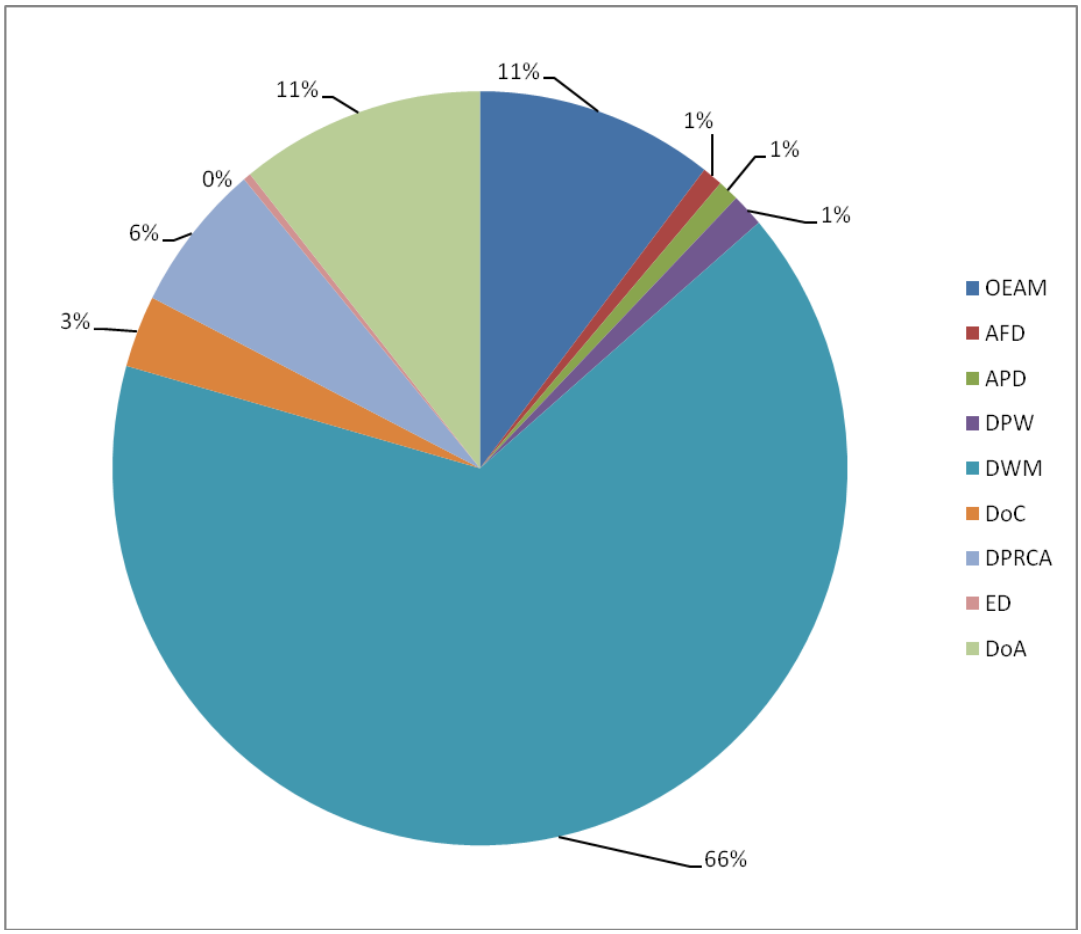

Figure 3: Percentage of Total Emissions by Department

Figure 4 the monthly carbon dioxide emissions from electricity used by City of Atlanta facilities. It shows that electricity use is relatively constant throughout the year.

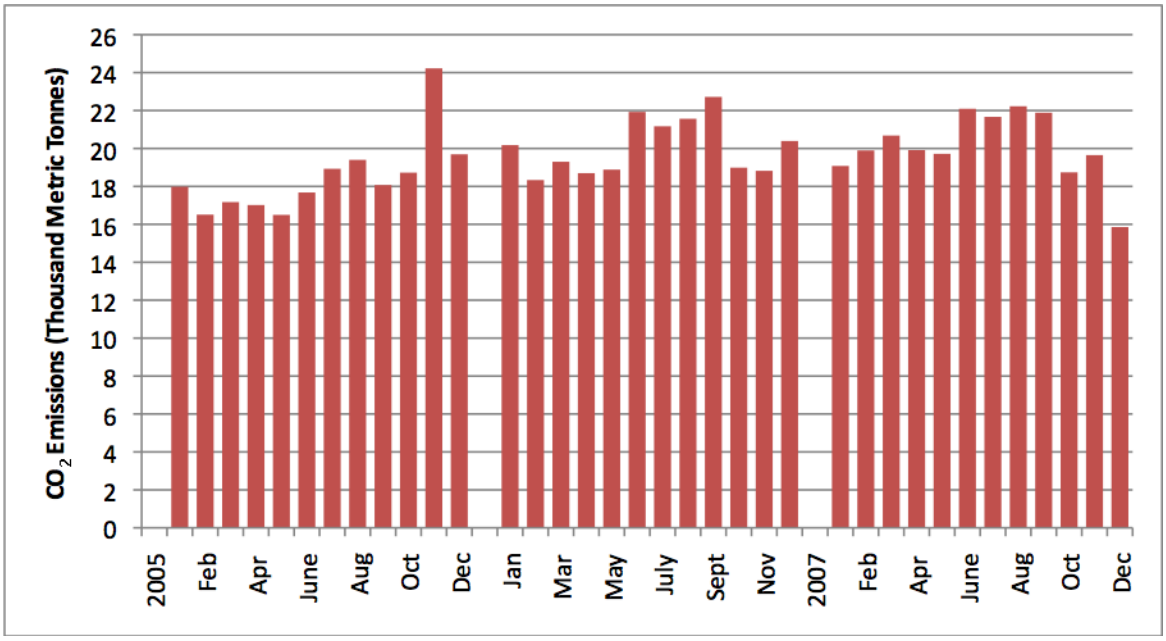

Figure 4: Facility Electricity CO_2 Emissions 2005-2007

Figure 5, 6, and 7 show the total CO_2, electricity CO_2, and natural gas CO_2 emissions from the Atlanta Airlines Terminal Corporation (AATC). Natural gas consumption is greatest in the summer, which may be due to the use of natural gas powered chillers.

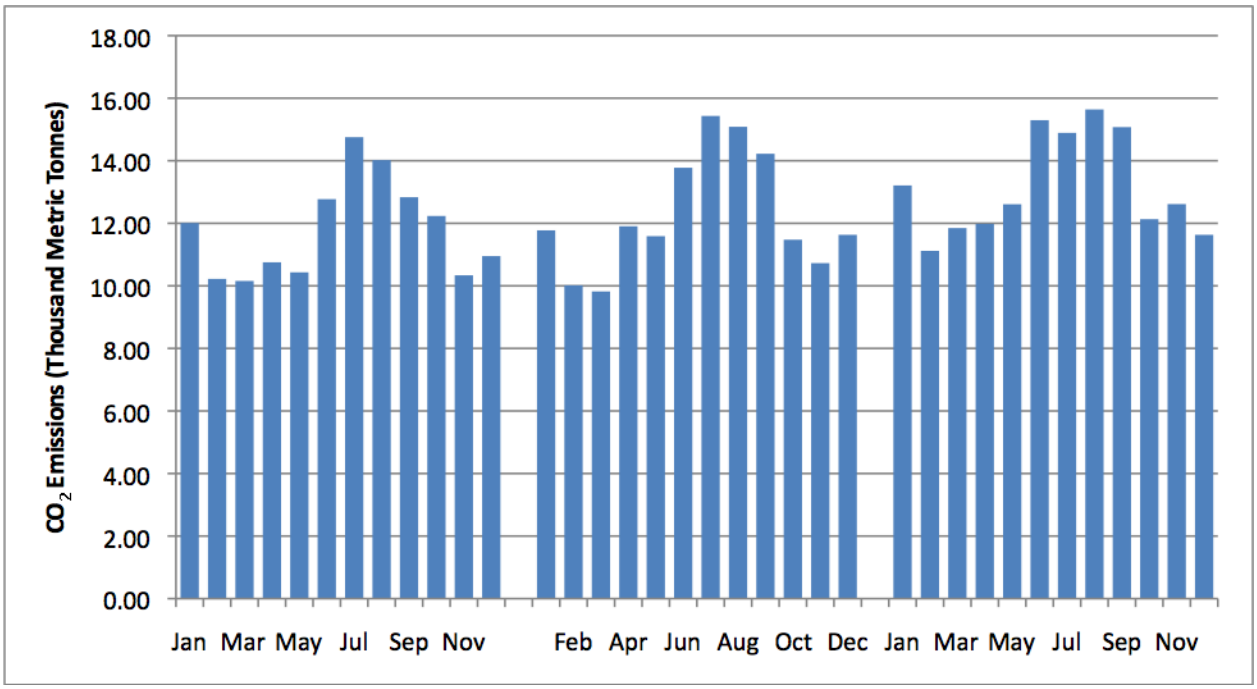

Figure 5: Total AATC CO_2 Emissions from Electricity and Natural Gas 2005-2007

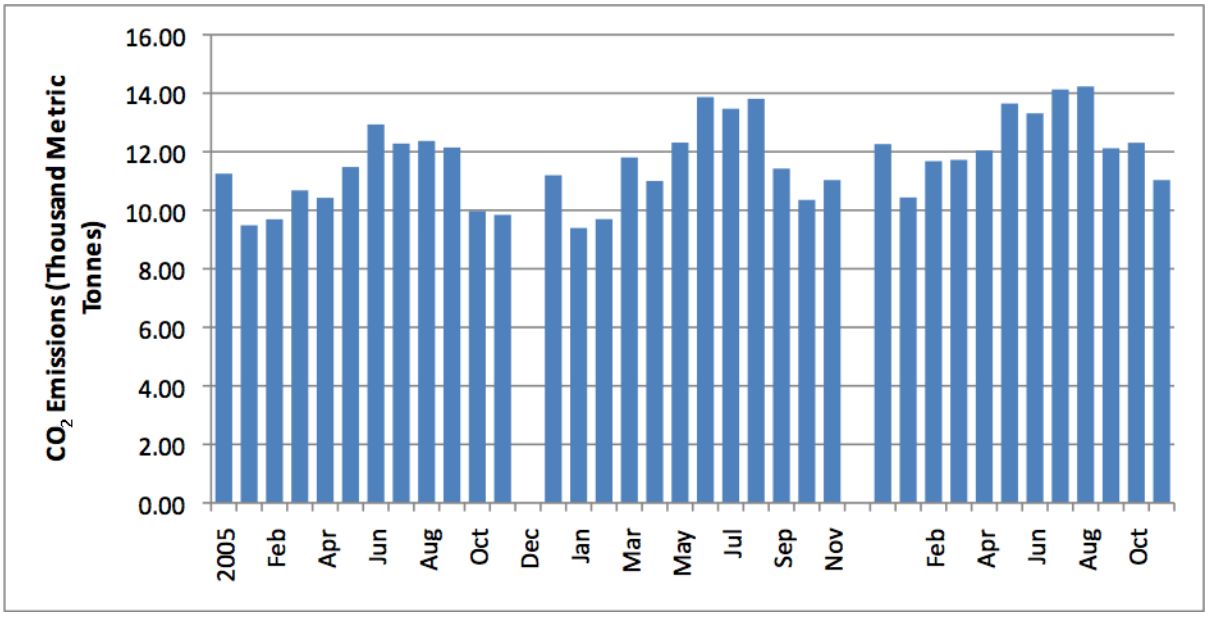

Figure 6: AATC Electricity CO_2 Emissions 2005-2007

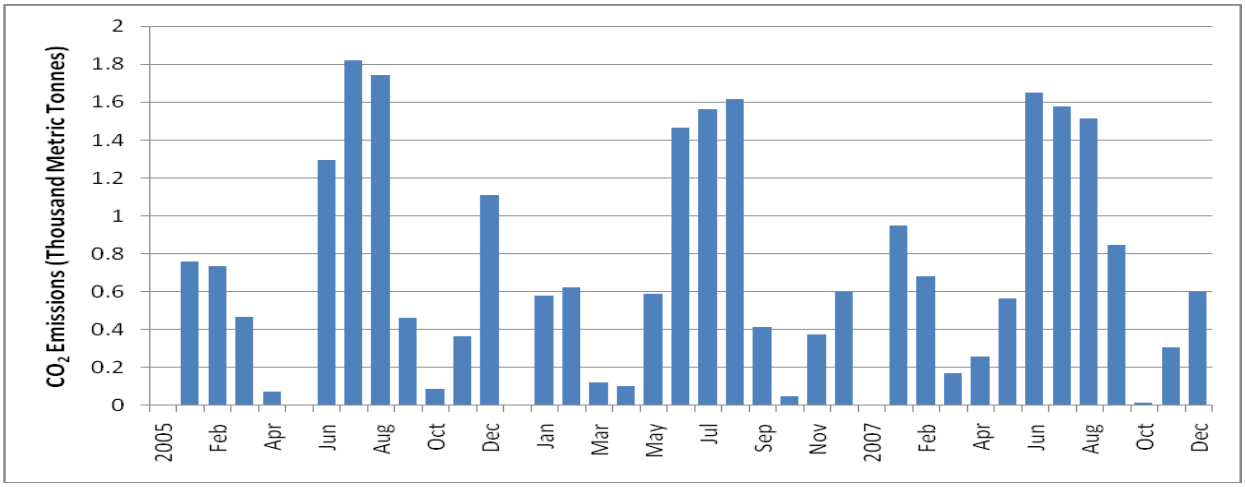

Figure 7: AATC Natural Gas CO_2 Emissions 2005-2007

The 540 thousand metric tons of greenhouse gases emitted by the City of Atlanta facilities and vehicles can be put into perspective in a number of ways:

Comparison with residential energy use: The 540 thousand metric tonnes of greenhouse gases is equivalent to the greenhouse gas emissions from the household energy use of about 150,000 Atlanta residents.[27]

SIDE NOTE: Based on 3.85 metric tons CO_2 residential emissions per capita.

Comparison with recycling: The US EPA estimates that each pound of waste recycled (rather than landfilled) reduces greenhouse gas emissions by 2.9 pounds.[28] Thus 540 thousand metric tonnes of CO_2 is equivalent to the amount of greenhouse gases avoided if Atlanta residents recycled 50% of their waste.

SIDE NOTE: Based on 500,000 people, 4.6 lbs waste/day/person[29], 365 days/year

Comparison with passenger vehicles: The 540 thousand metric tonnes of greenhouse gases is equivalent to the annual greenhouse gas emissions from 98,000 passenger vehicles.[28]

Comparison with trees planted: The carbon sequestered by about 14 million tree seedlings grown for 10 years is equivalent to the greenhouse gases emitted by the City in 2007.[28]

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[27] Sarzinski, A., Brown, M., and Southworth, F., 2008. Shrinking the Carbon Footprint of Metropolitan America. Metro Area Profile: Atlanta-Sandy Springs-Marietta, GA. http://www.brookings.edu/reports/2008/05_carbon_footprint_sarzynski.aspx

[28] US EPA 2008. Greenhouse Gas Equivalencies Calculator. http://www.epa.gov/cleanenergy/energy-resources/calculator.html

[29] US EPA 2008, Municipal Solid Waste in the United States: Facts and Figures. http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf

In addition, the carbon emissions from City operations can be compared with the emissions generated by all the City employees traveling to and from work.[30] City of Atlanta employees consume approximately 11,000 gallons of gasoline per day while commuting. This is a total annual carbon dioxide emission of 25 thousand metric tonnes, or about 5% of the greenhouse gas emissions from City operations.

Approaches to Reduce City of Atlanta Greenhouse Gas Emissions

Reducing energy use will reduce greenhouse gas emissions. The City of Atlanta has already been working to identify cost-effective energy efficiency improvements in City of Atlanta operations. Heating and cooling normally represents the bulk of energy use in buildings. In addition, there are likely numerous opportunities for more efficient lighting in City of Atlanta facilities.

Another way to reduce greenhouse emissions is to change the fuel type used to generate electricity. Currently, several changes and additions to Georgia's electricity system are under consideration or development. Plant McDonough, located within the Atlanta perimeter, is converting from coal to natural gas, and will have a capacity of 2.4 GW when all three natural gas units are in place.[31] Plant Mitchell, located near Albany, is converting from coal to biomass, and will have a capacity of 96 MW.[32] Plant Vogtle, located 170 miles from Atlanta, may add two 1154 MW nuclear units. Each of these developments would reduce the electric system's greenhouse gas emissions per kilowatt-hour. In contrast, adding new coal fired-power plants would increase greenhouse gas emissions. Since electricity accounts for roughly 80% of carbon dioxide emissions by the

[30] Data from Schinder C, Roberson J, Robinson R, Wang J, Ohiaeri I, Eddy G, Spears, Employee Commuter Transportation Patterns and Commute Alternatives, Emory University, Report for ENVS 491, April 2008.

[31] http://pressroom-publisher.southerncompany.com/gpc/gpc28.html

[32] http://www.redorbit.com/news/business/1531932/georgia_power_seeks_approval_to_convert_coalfired_plant_mitchell_to/index.html

City of Atlanta, reducing the electricity CO_2 emission factor by 1% would decrease the City's emissions by 0.8% or 4,300 metric tonnes.

The landfill gas produced by the City's landfills and by the other Atlanta area landfills consists of approximately 50% methane (natural gas) and 50% carbon dioxide. It can be combusted and converted to electricity; Southern Company already operates a landfill gas power plant in the state of Georgia. Alternatively, if the landfill is near a factory or other facility that requiring a heat source, landfill gas can be used and combusted directly to produce heat; there are several operating landfill-gas-to-heat facilities in Georgia. There are numerous landfills in the Atlanta area that may provide opportunities for renewable energy development.

Biomass is another low-cost option for renewable electricity. Atlanta is already using tree trimmings and other wood wastes to displace some fossil fuel use. At a larger scale, there is potential to convert more Georgia power plants either to co-firing biomass with coal, or entirely to biomass. Near-term use of biomass in existing coal-fired power plants could help Georgia meet a potential state or federal Renewable Electricity Standard, and would begin to develop the infrastructure for future high-tech biomass energy facilities in Georgia.

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